Activity Title: Predict, Share, Observe, and Explain (PSOE) Lab: Why is it important to monitor the tides, and how is it done?

Subject (Focus/Topic): This lesson addresses the cause of tides, and several reasons why it is important to monitor the tides.

Grade Level: This lesson is meant for seventh and eighth grade students.

Average Learning Time: This lesson will take two fifty-minute class periods to teach.

Lesson Summary (Overview/Purpose): In this lesson, students will make predictions on monitoring tides, share their predictions with classmates, do research on a NOAA website to test their predictions, and explain if their ideas were or were not supported.

Overall Concept (Big Idea/Essential Question): Students will explore the idea of how scientists monitor the tides and why it is important to do so. Students will understand that mapping the ocean floor depends on accurate tidal data, and that careful monitoring of the tides is an important aspect of hydrographic surveying.

Specific Concepts (Key Concepts):

1. Students will understand the cause of tides, and the tidal cycle observed on Earth.
2. Students will understand old and new systems that NOAA uses for monitoring the tides and why it is important to use more than one system.
3. Students will understand how NOAA applies tidal data in order to create nautical charts.

Focus Questions (Specific Questions):

1. What is the force that causes tides on Earth?
2. How many high and low tides occur each day in most places on Earth?
3. What is the difference between a high and a low tide?
4. Why is it important to monitor the tides?
5. How are tides monitored around the world, and who is responsible for doing this work?
6. How has the technology evolved when it comes to monitoring the tides?
7. Why is it important to monitor the tides using more than one system in a given area?
8. How is tidal data used once it is collected?
9. Why is it so important to have accurate tidal data for nautical charts such as the ones that NOAA produces?

Objective/Learning Goals:

1. Students will achieve at least 85% accuracy on the post-assessment questions presented at the end of the lesson. Clicker questions
2. Students will be able to list at least three similarities and differences between the new and the old system for monitoring tides.
3. Students will give at least two reasons why it is important to monitor the tides, and state at least one other thing that they've learned from this lesson.

Background Information: Students need to have a basic understanding of the position of the Sun, Earth, and the moon. Students should be familiar with the force of gravity and inertia and should understand how these forces can have observable effects on the Sun, Earth, and moon.

Common Misconceptions/Preconceptions: Students at this age may not know that the moon and Sun affect the Earth's tides. Students who have not grown up or visited a coastal community may not even know what a tide is or that they are predictable. It is important to have a tide table available to show students that the tides can be accurately predicted each day. This can lead to a discussion on how these tide tables are created.

Materials:

- Pre and post assessment questions
- Whiteboard
- PSOE Lab Instructions (see attached PDF)

Technical Requirements:

- ActiveExpression Classroom Voters (optional)
- Computers with internet access– one per student or may be done in pairs
    - iPads or other devices capable of accessing the internet may be used in place of computers

Teacher Preparation: The teacher should have an understanding of tides and how they are monitored, and should be familiar with the NOAA website that is used throughout this lesson. (http://oceanservice.noaa.gov/education/tutorial_tides/tides01_intro.html) A PowerPoint, or something comparable, should be prepared before day one with pre-assessment questions and the PSOE Lab Instructions. Please see the attached *NOAA Tides* PDF for an example. Finally, the teacher should ensure that all computers are functioning and have reliable internet access.

Keywords:

1. tides
2. gravity
3. inertia
4. tide monitoring station
5. nautical chart

Pre-assessment Strategy/Anticipatory Set (Optional): See day one of lesson procedure.

Lesson Procedure:

- Day One:
    - Students will be given time to answer pre-assessment questions using the clickers. (see attached PDF)
    - Students will now copy down the following questions and use their Astronomy textbooks in order to help them answer the following questions:
        1. What are tides, and how often do they occur?
        2. What causes tides?

3. Sketch and label the location of the Sun, Earth, and moon during Spring and Neap tides.
4. What's the difference between a low tide and a high tide?

- The class will discuss the answers to the four questions as a whole group.
- For closure, students will answer the following Ticket-Out-the-Door question: Explain why there are two high tides and two low tides each day.

- Day Two:
  - As a class, the students will review what was done during the lesson on Day One.
  - Predict:
    1. Students will be asked to make a prediction to the following question in their science notebook: What is it important to monitor the tides, and how is it done?
  - Share:
    1. Students will find a partner and decide which partner is partner one and which is partner two.
    2. Partner one will have one minute to share their predictions while partner two is writing down all that they say. Now partners switch roles.
  - Observe (Research):
    1. The class will begin their research on why it is important to monitor tides.
    2. Students will visit the following link: http://oceanservice.noaa.gov/education/kits/tides/tides09_monitor.html
    3. Students will read the information on the page, and write a brief summary about the importance of monitoring tides.
    4. Students will be instructed to click the "next" button at the top of the page and read about the "old system" and the "new system" for how tides are measured.
    5. Students will be asked to compare and contrast the new and old systems.
  - Explain:
    1. Students will reflect on their research.
       - Were your predictions supported?
       - Did you discover any new information?
    2. Students will share out first with their partner and then with the class.
  - Closure
    1. Students will complete post-assessment questions with the clickers.

Assessment and Evaluation: Student understanding will be measured in the following ways:

- Pre-assessment:
  - Responses to the clicker-based pre-assessment questions
  - Classroom discussion
- Formative assessments:
  - Partner, small-group, and classroom discussions throughout the lesson
  - Astronomy textbook questions and answers
  - Ticket-Out-the-Door question at the end of day one
- Summative assessments:
  - Responses to the clicker-based post-assessment questions
  - Compare/Contrast of the new and old systems for monitoring tides

- Student reflection of research – list two reasons why it is important to monitor tides, and one thing that the student learned from the lesson

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Creation date: February 24th, 2014

National Science Education Standards Addressed:

- Science Inquiry Standard, Grades 5-8, Explanation and evidence
- Physical Science Standards, Grades 5-8, Motions and forces
- Earth and Space Science Standards, Levels 5-8, Earth in the solar system

Ocean Literacy Principles Addressed:

- The Earth has one big ocean with many features.
  - *"Throughout the ocean there is one interconnected circulation system powered by wind, tides, the force of Earth's rotation (Coriolis effect), the Sun and water density differences. The shape of ocean basins and adjacent land masses influence the path of circulation. This "global ocean conveyor belt" moves water throughout all of the ocean basins, transporting energy (heat), matter, and organisms around the ocean. Changes in ocean circulation have a large impact on the climate and cause changes in ecosystems."*
  - *"Sea level is the average height of the ocean relative to the land, taking into account the differences caused by tides. Sea level changes as plate tectonics cause the volume of ocean basins and the height of the land to change. It changes as ice caps on land melt or grow. It also changes as sea water expands and contracts when ocean water warms and cools."*
- The ocean and humans are inextricably interconnected.
  - *"The ocean provides food, medicines, and mineral and energy resources. It supports jobs and national economies, serves as a highway for transportation of goods and people, and plays a role in national security."*

State Science Standard(s) Addressed: (Oregon)

- 7.2P.1 Identify and describe types of motion and forces and relate forces qualitatively to the laws of motion and gravitation.
- 8.2E.3 Explain the causes of patterns of atmospheric and oceanic movement and the effects on weather and climate.

Other National or State Standards Addressed (Optional) Additional Resources: N/A